CLAIMS

What is claimed is:

1. A method of treating a condition associated with a glycosaminoglycan-associated molecular interaction in a subject, comprising administering to a subject a therapeutically effective amount of a therapeutic compound for modulating said glycosaminoglycan-associated molecular interaction, said therapeutic compound having the formula:

$$Q-[-Y^{-}X^{+}]_n$$

wherein Y^- is an anionic group at physiological pH; Q is a carrier molecule; X^+ is a cationic group; and n is an integer selected such that the biodistribution of said therapeutic compound for an intended target site is not prevented while maintaining activity of the therapeutic compound, or a pharmaceutically acceptable salt or ester thereof, such that said glycosaminoglycan-associated molecular interaction is modulated and said condition is treated.

2. The method of claim 1, wherein said glycosaminoglycan-associated molecular interaction does not include amyloidosis.

3. The method of claim 1, wherein said carrier molecule is selected from the group consisting of a carbohydrate, a polymer, a peptide, a peptide derivative, an aliphatic group, an alicyclic group, a heterocyclic group, an aromatic group and combinations thereof.

4. The method of claim 3, wherein said carrier molecule is an aliphatic group.

5. The method of claim 4, wherein said therapeutic compound is selected from the group consisting of 1,3-propanedisulfonic acid, 3-amino-1-propanesulfonic acid, 3-dimethylamino-1-propanesulfonic acid sodium salt, 2-(3-sulfopropyl)-1,2,3,4-tetrahydro-9*H*-pyrido[3,4-*b*]indole, sodium salt, 3-[2-(6-methoxy-1,2,3,4-tetrahydroisoquinolinyl)]-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(3-hydroxy-1-propyl)amino-1-propanesulfonic acid, (-)3-[(*R*)-2-hydroxy-1-propyl]amino-1-propanesulfonic acid, 3-(4-hydroxy-1-butyl)amino-1-

propanesulfonic acid, 3-(5-hydroxy-1-pentyl)amino-1-propanesulfonic acid, 3-(6-hydroxy-1-hexyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-hexylamino-1-propanesulfonic acid, 3-undecylamino-1-propanesulfonic acid, and 3-octadecylamino-1-propanesulfonic acid, and pharmaceutically acceptable salts or esters thereof.

6. The method of claim 1, wherein said glycosaminoglycan-associated molecular interaction is associated with a bacterial infection caused by a bacterium, provided that when said bacterium is *Chlamydia trachomatis*, the therapeutic compound is not carrageenan, pentosan polysulfate, fucoidan, dextran sulfate, heparin, heparan sulfate or dermatan sulfate.

7. The method of claim 6, wherein said bacterium includes *Chlamydia trachomatis, Staphylococcus aureus, Pseudomonas aeruginosa, Legionella pneumophila, Bordetella pertussis*, and *Mycoplasma pneumoniae*.

8. The method of claim 6, wherein said method includes inhibiting interaction between said bacterium and a cell surface.

10. The method of claim 1, wherein said glycosaminoglycan-associated molecular interaction is associated with a viral infection caused by a virus, with the proviso that when the viral infection is cytomegalovirus the therapeutic compound is not a chondroitin sulfate.

11. The method of claim 10, wherein said viral infection includes viruses associated with *Herpesviridae*.

12. The method of claim 10, wherein said method includes inhibiting interaction between said viruses and a cell surface.

13. The method of claim 1, wherein said therapeutic compound has the following formula

$$Q—[—SO_3^-X^+]_n$$

wherein Q is a carrier molecule; X^+ is a cationic group; and n is an integer selected such that the biodistribution of the therapeutic compound for an intended target site is not prevented while maintaining activity of the therapeutic compound.

14. The method of claim 13, wherein the carrier molecule is selected from the group consisting of a carbohydrate, a polymer, a peptide, a peptide derivative, an aliphatic group, an alicyclic group, a heterocyclic group, an aromatic group and combinations thereof.

15. The method of claim 14, wherein the carrier molecule is an aliphatic group.

16. The method of claim 15, wherein the therapeutic compound is selected from the group consisting of 1,3-propanedisulfonic acid, 3-amino-1-propanesulfonic acid, 3-dimethylamino-1-propanesulfonic acid sodium salt, 2-(3-sulfopropyl)-1,2,3,4-tetrahydro-9*H*-pyrido[3,4-*b*]indole, sodium salt, 3-[2-(6-methoxy-1,2,3,4-tetrahydroisoquinolinyl)]-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(3-hydroxy-1-propyl)amino-1-propanesulfonic acid, (-)3-[(*R*)-2-hydroxy-1-propyl]amino-1-propanesulfonic acid, 3-(4-hydroxy-1-butyl)amino-1-propanesulfonic acid, 3-(5-hydroxy-1-pentyl)amino-1-propanesulfonic acid, 3-(6-hydroxy-1-hexyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-hexylamino-1-propanesulfonic acid, 3-undecylamino-1-propanesulfonic acid, and 3-octadecylamino-1-propanesulfonic acid, and pharmaceutically acceptable salts or esters thereof.

17. A method of modulating interaction between an infectious agent and a glycosaminoglycan in a subject comprising administering to a subject a therapeutically effective amount of a therapeutic compound for treating an interaction between an infectious agent and a glycosaminoglycan, the therapeutic compound comprising at least one sulfonate group covalently attached to a carrier molecule, or a pharmaceutically acceptable salt or ester thereof, such that said interaction is modulated.

18. The method of claim 17, wherein the carrier molecule is selected from the group consisting of a carbohydrate, a polymer, a peptide, a peptide derivative, an aliphatic group, an alicyclic group, a heterocyclic group, an aromatic group and combinations thereof.

19. The method of claim 18, wherein the carrier molecule is an aliphatic group.

20. The method of claim 17, wherein the therapeutic compound is selected from the group consisting of 1,3-propanedisulfonic acid, 3-amino-1-propanesulfonic acid, 3-dimethylamino-1-propanesulfonic acid sodium salt, 2-(3-sulfopropyl)-1,2,3,4-tetrahydro-9*H*-pyrido[3,4-*b*]indole, sodium salt, 3-[2-(6-methoxy-1,2,3,4-tetrahydroisoquinolinyl)]-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(3-hydroxy-1-propyl)amino-1-propanesulfonic acid, (-)3-[(*R*)-2-hydroxy-1-propyl]amino-1-propanesulfonic acid, 3-(4-hydroxy-1-butyl)amino-1-propanesulfonic acid, 3-(5-hydroxy-1-pentyl)amino-1-propanesulfonic acid, 3-(6-hydroxy-1-hexyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-hexylamino-1-propanesulfonic acid, 3-undecylamino-1-propanesulfonic acid, and 3-octadecylamino-1-propanesulfonic acid, and pharmaceutically acceptable salts or esters thereof.

21. The method of claim 17, wherein said glycosaminoglycan-associated molecular interaction is associated with a bacterial infection caused by a bacterium, provided that when said bacterium is *Chlamydia trachomatis*, the therapeutic compound is not carrageenan, pentosan polysulfate, fucoidan, dextran sulfate, heparin, heparan sulfate or dermatan sulfate.

22. The method of claim 21, wherein said bacterium includes *Chlamydia trachomatis, Staphylococcus aureus, Pseudomonas aeruginosa, Legionella pneumophila, Bordetella pertussis*, and *Mycoplasma pneumoniae.*

23. The method of claim 21, wherein said method includes inhibiting interaction between said bacterium and a cell surface.

24. The method of claim 17, wherein said interaction between an infectious agent and a glycosaminoglycan is associated with a viral infection caused by a virus, with the proviso that when the viral infection is cytomegalovirus the therapeutic compound is not a chondroitin sulfate.

25. The method of claim 24, wherein said viral infection includes viruses associated with *Herpesviridae*.

26. The method of claim 24, wherein said method includes inhibiting interaction between said viruses and a cell surface.

27. The method of claim 17, wherein said therapeutic compound has the following formula

$$Q\text{—}[\text{—}SO_3^{-}X^{+}]_n$$

wherein Q is a carrier molecule; X^+ is a cationic group; and n is an integer selected such that the biodistribution of the therapeutic compound for an intended target site is not prevented while maintaining activity of the therapeutic compound, such that the glycosaminoglycan-associated molecular interaction is treated.

28. The method of claim 27, wherein the carrier molecule is selected from the group consisting of a carbohydrate, a polymer, a peptide, a peptide derivative, an aliphatic group, an alicyclic group, a heterocyclic group, an aromatic group and combinations thereof.

29. The method of claim 28, wherein the carrier molecule is an aliphatic group.

30. The method of claim 27, wherein the therapeutic compound is selected from the group consisting of 1,3-propanedisulfonic acid, 3-amino-1-propanesulfonic acid, 3-dimethylamino-1-propanesulfonic acid sodium salt, 2-(3-sulfopropyl)-1,2,3,4-tetrahydro-9*H*-pyrido[3,4-*b*]indole, sodium salt, 3-[2-(6-methoxy-1,2,3,4-tetrahydroisoquinolinyl)]-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(3-hydroxy-1-propyl)amino-1-propanesulfonic acid, (-)3-[(*R*)-2-hydroxy-1-propyl]amino-1-propanesulfonic acid, 3-(4-hydroxy-1-butyl)amino-1-propanesulfonic acid, 3-(5-hydroxy-1-pentyl)amino-1-propanesulfonic acid, 3-(6-hydroxy-1-hexyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-

propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-hexylamino-1-propanesulfonic acid, 3-undecylamino-1-propanesulfonic acid, and 3-octadecylamino-1-propanesulfonic acid, and pharmaceutically acceptable salts or esters thereof.

31. A packaged pharmaceutical composition for treating a glycosaminoglycan-associated molecular interaction, comprising

a container holding a therapeutically effective amount of a pharmaceutical composition for treating a glycosaminoglycan-associated molecular interaction in a subject, said pharmaceutical composition comprising at least one therapeutic compound comprising at least one sulfonate group covalently attached to a carrier molecule, or a pharmaceutically acceptable salt thereof; and

instructions for using said pharmaceutical composition for treating the glycosaminoglycan-associated molecular interaction.

32. The packaged pharmaceutical of claim 31, wherein the carrier molecule is selected from the group consisting of a carbohydrate, a polymer, a peptide, a peptide derivative, an aliphatic group, an alicyclic group, a heterocyclic group, an aromatic group and combinations thereof.

33. The packaged pharmaceutical of claim 32, wherein the carrier molecule is an aliphatic group.

34. The packaged pharmaceutical of claim 31, wherein the therapeutic compound is selected from the group consisting of 1,3-propanedisulfonic acid, 3-amino-1-propanesulfonic acid, 3-dimethylamino-1-propanesulfonic acid sodium salt, 2-(3-sulfopropyl)-1,2,3,4-tetrahydro-9*H*-pyrido[3,4-*b*]indole, sodium salt, 3-[2-(6-methoxy-1,2,3,4-tetrahydroisoquinolinyl)]-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(3-hydroxy-1-propyl)amino-1-propanesulfonic acid, (-)3-[(*R*)-2-hydroxy-1-propyl]amino-1-propanesulfonic acid, 3-(4-hydroxy-1-butyl)amino-1-propanesulfonic acid, 3-(5-hydroxy-1-pentyl)amino-1-propanesulfonic acid, 3-(6-hydroxy-1-hexyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-

hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-hexylamino-1-propanesulfonic acid, 3-undecylamino-1-propanesulfonic acid, and 3-octadecylamino-1-propanesulfonic acid, and pharmaceutically acceptable salts or esters thereof.

35. A composition for treating a glycosaminoglycan-associated molecular interaction in a subject, comprising

a therapeutically effective amount of a therapeutic compound comprising at least one sulfonate group covalently attached to a carrier molecule, or a pharmaceutically acceptable salt thereof; and

a pharmaceutically acceptable carrier, such that a glycosaminoglycan-associated molecular interaction is treated.

36. The composition of claim 35, wherein the carrier molecule is selected from the group consisting of a carbohydrate, a polymer, a peptide, a peptide derivative, an aliphatic group, an alicyclic group, a heterocyclic group, an aromatic group and combinations thereof.

37. The composition of claim 36, wherein the carrier molecule is an aliphatic group.

38. The composition of claim 35, wherein the therapeutic compound is selected from the group consisting of 1,3-propanedisulfonic acid, 3-amino-1-propanesulfonic acid, 3-dimethylamino-1-propanesulfonic acid sodium salt, 2-(3-sulfopropyl)-1,2,3,4-tetrahydro-9*H*-pyrido[3,4-*b*]indole, sodium salt, 3-[2-(6-methoxy-1,2,3,4-tetrahydroisoquinolinyl)]-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(3-hydroxy-1-propyl)amino-1-propanesulfonic acid, (-)3-[(*R*)-2-hydroxy-1-propyl]amino-1-propanesulfonic acid, 3-(4-hydroxy-1-butyl)amino-1-propanesulfonic acid, 3-(5-hydroxy-1-pentyl)amino-1-propanesulfonic acid, 3-(6-hydroxy-1-hexyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-hexylamino-1-propanesulfonic acid, 3-undecylamino-1-propanesulfonic acid, and 3-octadecylamino-1-propanesulfonic acid, and pharmaceutically acceptable salts or esters thereof.

39. The composition of claim 35, wherein the therapeutic compound has the following formula

$$Q—[—SO_3^-X^+]_n$$

wherein Q is a carrier molecule; X^+ is a cationic group; and n is an integer selected such that the biodistribution of the therapeutic compound for an intended target site is not prevented while maintaining activity of the therapeutic compound; and

a pharmaceutically acceptable carrier, such that the glycosaminoglycan-associated molecular interaction is treated.

40. The composition of claim 39, wherein the carrier molecule is selected from the group consisting of a carbohydrate, a polymer, a peptide, a peptide derivative, an aliphatic group, an alicyclic group, a heterocyclic group, an aromatic group and combinations thereof.

41. The composition of claim 40, wherein the carrier molecule is an aliphatic group.

42. The composition of claim 39, wherein the therapeutic compound is selected from the group consisting of 1,3-propanedisulfonic acid, 3-amino-1-propanesulfonic acid, 3-dimethylamino-1-propanesulfonic acid sodium salt, 2-(3-sulfopropyl)-1,2,3,4-tetrahydro-9*H*-pyrido[3,4-*b*]indole, sodium salt, 3-[2-(6-methoxy-1,2,3,4-tetrahydroisoquinolinyl)]-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(3-hydroxy-1-propyl)amino-1-propanesulfonic acid, (-)3-[(*R*)-2-hydroxy-1-propyl]amino-1-propanesulfonic acid, 3-(4-hydroxy-1-butyl)amino-1-propanesulfonic acid, 3-(5-hydroxy-1-pentyl)amino-1-propanesulfonic acid, 3-(6-hydroxy-1-hexyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-(2-hydroxyethyl)amino-1-propanesulfonic acid, 3-hexylamino-1-propanesulfonic acid, 3-undecylamino-1-propanesulfonic acid, and 3-octadecylamino-1-propanesulfonic acid, and pharmaceutically acceptable salts or esters thereof.

43. A method for treating a subject afflicted with Chlamydia, comprising administering to a subject a therapeutically effective amount of a therapeutic compound for treating Chlamydia, the therapeutic compound having the formula:

$$Q\text{—}[\text{—}Y^{-}X^{+}]_n$$

wherein Y^- is an anionic group at physiological pH; Q is a carrier molecule; X^+ is a cationic group; and n is an integer selected such that the biodistribution of the therapeutic compound for an intended target site is not prevented while maintaining activity of the therapeutic compound, provided that the therapeutic compound is not a sulfated polysaccharide; such that the subject afflicted with Chlamydia is treated.

44. A method for treating a subject afflicted with HSV, comprising administering to a subject a therapeutically effective amount of a therapeutic compound for treating HSV, the therapeutic compound having the formula:

$$Q\text{—}[\text{—}Y^{-}X^{+}]_n$$

wherein Y^- is an anionic group at physiological pH; Q is a carrier molecule; X^+ is a cationic group; and n is an integer selected such that the biodistribution of the therapeutic compound for an intended target site is not prevented while maintaining activity of the therapeutic compound, provided that the therapeutic compound is not a sulfated polysaccharide; such that the subject afflicted with HSV is treated.